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Alfalfa Hay Inclusion Rate in Wet Corn Gluten Feed Based Diets

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Summary

In this experiment, we evaluated the effects of varying alfalfa inclusion rate in diets containing 31% wet corn gluten feed on a dry matter basis. Eighty lactating Holstein cows were allocated into groups of 10 and assigned to 1 of 8 pens balanced for parity, stage of lactation, and milk yield. Diets were formulated to contain 0, 7, 14, or 21% alfalfa on a dry matter basis. Diets containing greater proportions of alfalfa had less corn silage and soybean meal but more corn grain. Feed intake, milk production, body weight, and body condition score were monitored, and effects of increasing alfalfa inclusion rate were assessed. As more alfalfa was included in the ration, cows consumed more feed and had a tendency to produce more solids- and energy-corrected milk. In contrast, body weight gain decreased in diets with more alfalfa. These changes in milk and body weight indicate that metabolizable energy utilization shifted from body weight gain to milk production when more alfalfa was fed. With this in mind, an economic model was constructed to determine whether the added production from including alfalfa is enough to justify incorporating it in this type of ration. The model demonstrated that, despite minor losses in productivity, decreasing alfalfa inclusion rate may improve farm profitability by reducing feed costs and expenses associated with manure handling.

Introduction

Dairy nutritionists have traditionally relied heavily on alfalfa in formulating lactation rations; however, since 1995, the amount of land devoted to alfalfa production has declined by nearly 4 million acres. Not surprisingly, as the availability of alfalfa has decreased, its cost has increased nearly 50% in the last 20 years. As a result, nutritionists and producers are reconsidering the role of alfalfa in dairy rations.

Costs of other traditional feedstuffs also are increasing. As a result, dairy producers are adopting novel diet formulation strategies to help keep feed costs in check. Some producers have incorporated corn milling coproducts, in particular wet corn gluten feed (**WCGF**), into the ration. Wet corn gluten feed is a high-fiber feedstuff that can easily be incorporated into dairy cattle diets; however, researchers have observed mixed results when feeding WCGF at high levels.

It is easy to chemically balance a ration that includes large amounts of WCGF, but physical characteristics of the total mixed ration (**TMR**) must be accounted for. Although WCGF is relatively high in fiber, the small fiber particles provide little physically effective fiber. Many investigators have shown that physically effective fiber is necessary for maintaining proper rumen function and preventing milk fat depression. In ruminants, physically effective fiber stimulates rumination, which facilitates saliva secretion that, in turn, buffers the rumen. Because of the mechanical stimulation provided by alfalfa particles, feeding high levels of WCGF without alfalfa could lead to milk fat depression. Therefore, the objective of this study was to evaluate the effects of varying alfalfa inclusion rate in diets containing 31% WCGF on overall cow performance.

Experimental Procedures

Eighty lactating cows (averaging 178 days in milk) were allocated into groups of 10 and assigned to 1 of 8 pens. Pens were balanced for parity, stage of lactation, and milk yield. Diets containing 0, 7, 14, and 21% alfalfa on a dry matter (**DM**) basis were balanced for similar concentrations of crude protein, neutral detergent fiber, non-fiber carbohydrates, and starch. As a result, diets containing more alfalfa had less corn silage and soybean meal but more corn grain. Ingredients and nutrient composition of diets are listed in Table 1. Cows were fed a TMR twice daily, and amounts fed and refused were recorded daily by pen for each of the four 28-day periods. Feed samples of individual ingredients were collected on days 19, 21, 26, and 28 and composited by period for analysis. Cows were milked twice daily, and milk yield was recorded. Milk samples were collected for composition analysis from both milkings on days 21 and 28 of each period. Body weight was measured at the beginning and end of each period. Particle size of the TMR and refusals were measured by using the Penn State Particle Separator.

A breakeven analysis was conducted to determine whether the added milk production from including alfalfa is enough to justify feeding it in this type of ration. Changes in milk income, feed consumed, and feed costs were incorporated in a model to determine the relative difference in alfalfa vs. corn silage value (DM basis) at different milk:feed cost ratios. Diets compared were the 0 and 21% alfalfa treatments, and production and intake means for these treatments were used in this model. The value of alfalfa hay was fixed at $250/ton DM, and milk value was fixed at $20/hundred weight, whereas the value of corn silage and TMR cost varied with the alfalfa price differential and the milk:feed cost ratio, respectively. Addition of 21% alfalfa also allowed the exchange of 5% soybean meal for corn grain, and the cost differential between these commodities was set at $110/ton DM (soybean meal – corn grain). Changes to the fixed values had little effect on the results as presented, although the model was somewhat sensitive to the corn grain to soybean meal price differential.

Results and Discussion

Feed Intake, Milk Production, and Energetics

As the alfalfa inclusion rate increased, dry matter intake (**DMI**) increased ($P < 0.05$), and solids- and energy-corrected milk production tended ($P < 0.10$) to increase (Table 2). In contrast, as these variables either increased or tended to increase, body weight gain decreased ($P < 0.05$). As expected, increasing the alfalfa inclusion rate increased the proportion of large particles in diets, yet treatments did not affect milk fat yield or concentration. Lack of change in milk fat was partly because the amount of total fiber offered was similar across treatments. Furthermore, cows sorted against longer particles in the high alfalfa diets, resulting in smaller differences in particle sizes of the treatments as consumed.

Figure 1 represents the net energy used for body weight and milk production of cows consuming each diet. Because total net energy for productive use decreased with greater alfalfa inclusion, even as DMI increased, this relationship indicates that adding alfalfa hay decreased DM digestibility. In addition, because fecal production is highly dependent on DM digestibility, cows consuming diets that included more alfalfa probably produced more manure than cows on treatments with less alfalfa.

Economic Analysis

Although feeding greater levels of alfalfa tended to increase energy-corrected milk production, it also led to greater DMI, leading one to question whether it is economically beneficial to have

alfalfa in the ration. According to the breakeven analysis presented in Figure 2, if the price differential between alfalfa hay and corn silage falls below the breakeven line at a given milk:feed cost ratio, it is profitable to incorporate alfalfa into this type of ration. However, on the basis of responses to the 0 and 21% alfalfa treatments in this study, adding alfalfa to diets with high WCGF inclusion rates may not be profitable in current market conditions.

Table 1. Ingredient and nutrient composition of dietary treatments

	Dietary alfalfa			
Item	0%	7%	14%	21%
% As-fed				
Corn silage	58.0	50.9	42.8	33.3
Wet corn gluten feed	26.0	27.8	29.9	32.4
Alfalfa	0.0	4.1	8.7	14.2
Cottonseed	4.2	4.5	4.8	5.2
Corn grain	5.5	7.0	8.8	10.9
Soybean meal	2.8	2.0	1.1	0.0
Molasses	0.3	0.4	0.4	0.4
Expeller soybean meal	1.4	1.5	1.7	1.8
Micronutrient premix	1.8	1.8	1.8	1.8
% Dry matter				
Corn silage	41.0	33.9	26.7	19.4
Wet corn gluten feed	30.9	31.1	31.4	31.6
Alfalfa	0.0	6.6	13.4	20.2
Cottonseed	7.3	7.3	7.4	7.5
Corn grain	9.7	11.6	13.5	15.6
Soybean meal	4.9	3.4	1.7	0.0
Molasses	0.4	0.4	0.4	0.4
Expeller soybean meal	2.5	2.5	2.6	2.6
Micronutrient premix	3.2	3.1	2.8	2.6
Nutrients[1]				
Dry matter, % as-fed	52.5	55.8	59.5	63.9
Crude protein	16.5	16.5	16.7	16.7
Neutral detergent fiber	34.6	34.7	34.5	34.7
Starch	17.7	16.3	16.6	15.8
Non-fiber carbohydrate	36.0	36.0	36.4	36.5
Ether extract	3.8	3.7	3.6	3.6
Ash	9.1	9.0	8.8	8.6

[1]Nutrients other than dry matter expressed as a percentage of diet dry matter.

Table 2. Effects of treatments on performance of lactating cows

	Dietary alfalfa[1]					*P* value	
	0%	7%	14%	21%	SEM	Linear	Quadratic
Dry matter intake, lb/day	58.9	60.2	60.4	60.6	2.6	0.05	0.33
Milk yield, lb/day	68.1	68.6	69.9	69.0	3.3		*
Milk fat, %	3.75	3.81	3.75	3.79	0.11	0.79	0.83
Milk protein, %	3.47	3.46	3.44	3.44	0.07	0.38	0.84
Lactose, %	4.77	4.75	4.81	4.76	0.03	0.64	0.44
Somatic cell count, log	2.17	2.19	2.18	2.22	0.06	0.46	0.80
Milk urea nitrogen, mg/dL	12.6	13.0	12.7	12.5	0.48	0.31	0.05
Milk fat, lb/day	2.51	2.58	2.60	2.60	0.13	0.21	0.44
Milk protein, lb/day	2.34	2.34	2.38	2.36	0.07	0.15	0.48
Milk lactose, lb/day	3.26	3.26	3.40	3.33	0.18	0.02	0.18
Solids-corrected milk, lb/day	65.9	66.6	67.9	67.3	3.0	0.07	0.30
Energy-corrected milk, lb/day	72.5	73.4	74.5	74.1	3.2	0.09	0.32
Feed efficiency, ECM/DMI	1.16	1.14	1.16	1.15	0.03	0.75	0.88
Body weight change, lb/month	50.7	39.7	24.7	20.9	7.9	0.02	0.69
Body condition score change, unit/month	0.014	0.031	-0.006	-0.013	0.041	0.57	0.80

[1]Dry matter basis.
*Significant treatment by period interaction.

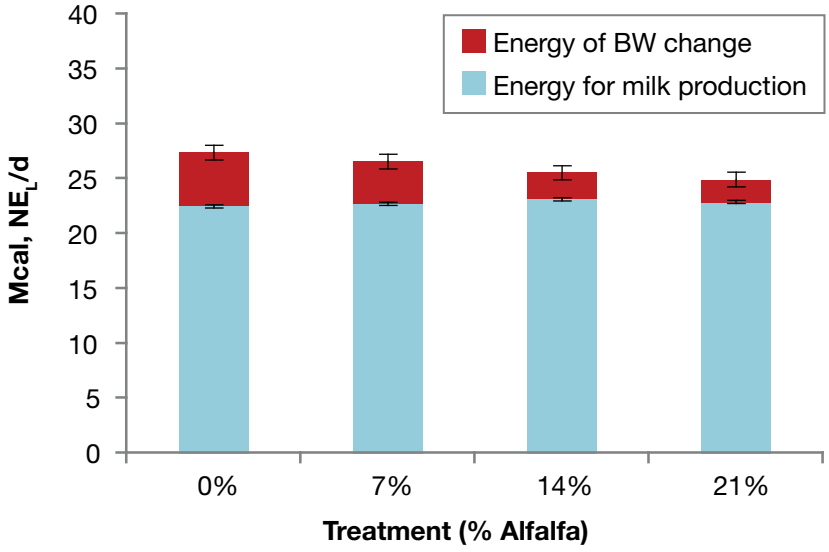

Figure 1. Total energy partitioned to milk production and body weight gain in cows fed varying levels of alfalfa. As alfalfa was added, total energy utilization tended ($P = 0.06$) to decrease linearly. For calculations, body weight gain was attributed to body fat gain.

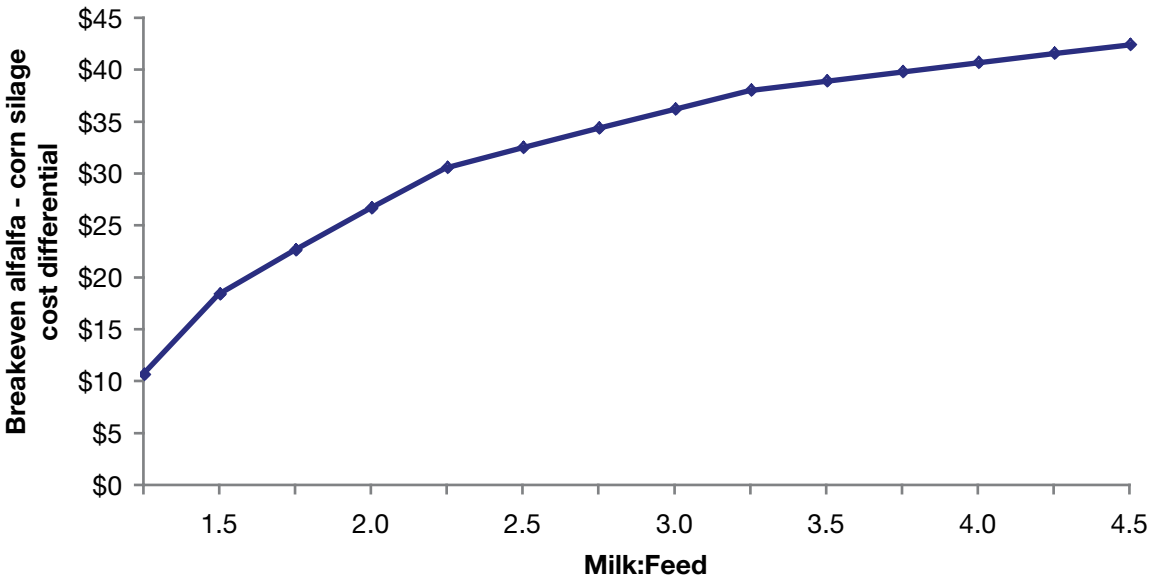

Figure 2. Breakeven analysis of alfalfa:corn silage cost differential. Breakeven analysis was conducted to determine whether the added milk production from including alfalfa is enough to justify feeding it in this type of ration. The line indicates the breakeven additional cost that can be paid for alfalfa compared with corn silage (per ton of dry matter) at a given milk:feed cost ratio. Values were calculated by using milk production and dry matter intake data from the 0 and 21% alfalfa diets.